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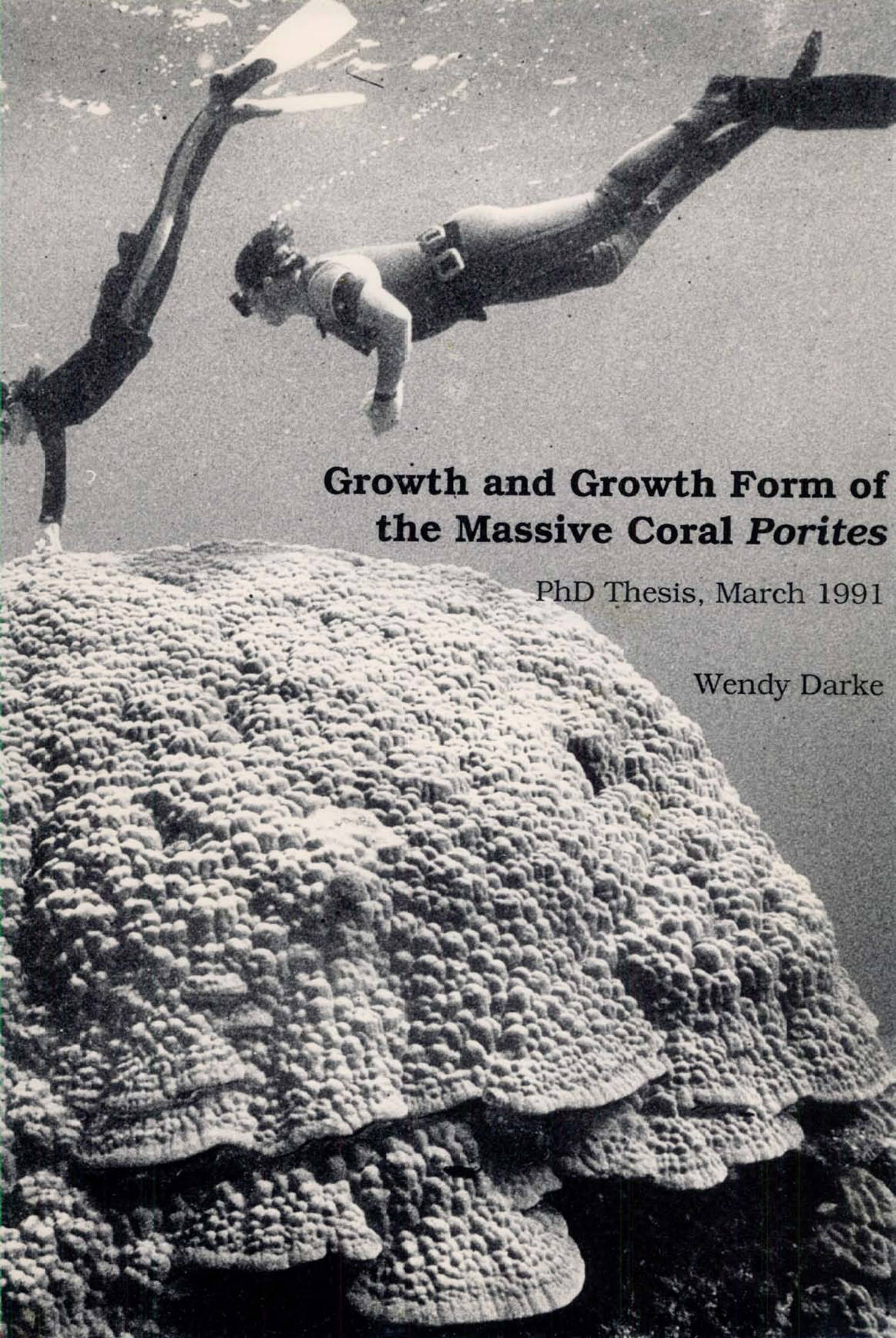
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**Growth and Growth Form of
the Massive Coral *Porites***

PhD Thesis, March 1991

Wendy Darke

**GROWTH AND GROWTH FORM
OF THE MASSIVE CORAL *PORITES***

**Thesis submitted by
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in March 1991**

**for the degree of Doctor of Philosophy in
the Marine Biology Department, School of Biological Sciences
at James Cook University of North Queensland**

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ABSTRACT

Massive *Porites* colonies develop a bumpy growth surface as they increase in size. Development of a bumpy growth surface occurs when skeletal growth no longer provides the necessary increase in surface area to accommodate tissue growth. A massive *Porites* colony becomes bumpy when it reaches a critical size determined by the ratio of its tissue growth to its skeletal growth. This ratio also determines the degree of bumpiness which develops at the growth surface.

X-radiographs of skeletal slices cut from the vertical growth axis of massive *Porites* colonies display annual density banding and skeletal architecture associated with corallites, that is, skeleton deposited by individual polyps. Density bands outline former positions of the growth surface. Examination of X-radiographs of *Porites* shows that new corallites are initiated on, or towards, the summit of bumps, whilst older corallites are compressed and ultimately occluded at the bottom of valleys formed between bumps. X-radiographs show that it takes 4 to 7 years from the formation of a corallite to its occlusion. Polyps on the growth surface of a bumpy *Porites* colony must, therefore, be continually lost. All polyps are lost and replaced during a 4 to 7 year period. Consequently, tissue covering the growth surface of a massive *Porites* colony can be no older than 7 years, even though the colony may have been growing for several centuries.

Computer models designed to simulate growth of a massive *Porites* colony indicated that the growth form displayed by a *Porites* colony is determined by the ratio of tissue growth to skeletal growth. Models having a relatively faster tissue growth compared with skeletal growth developed a bumpy surface sooner, and the amount of bumpiness developed was greater, than for models having a relatively slower tissue growth compared with skeletal growth. Predictions from computer models accorded with observations and measurements made on actual colonies and on X-radiographs of skeletal slices cut from colonies. Thus, the ratio of tissue growth to skeletal growth determines important aspects of the growth form displayed by massive *Porites* colonies.

The ratio of tissue growth to skeletal growth was shown to significantly affect the rate of polyp loss and replacement in *Porites* colonies. The longevity of polyps is less in *Porites* colonies displaying a well developed bumpy growth surface than in colonies displaying a smoother growth surface. Hence, the age of polyps, and therefore the tissue, covering a bumpy growth surface is less than polyps and tissue covering a smooth growth surface.

Skeletal surface area in massive *Porites* colonies was shown to be a useful indicator of tissue biomass. Measurements of change in surface area of *Porites* colonies with increasing size show that the rate of tissue growth must decrease as the colony grows. Development of a bumpy growth surface alleviates this geometric restriction for only months to a couple of years. Development of a bumpy growth surface is an indication that tissue growth is becoming constrained by skeletal growth. Once a colony becomes bumpy, the tissue growth is almost totally constrained by the rate by skeletal extension.

Significant differences in growth and growth form characterised massive *Porites* colonies collected from different reef environments. Measurements made on the colonies suggested that differences in environmental conditions probably altered the ratio of tissue growth to skeletal growth and caused the colonies to grow in different ways. Differences in growth were reflected in the resulting growth form. Information about relative rates of tissue and skeletal growth within a massive *Porites* colony gained from observations and measurements of the growth form can be used to provide further information about coral growth and details of environmental conditions obtaining during growth.

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DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

W M Darke

25 March 1991

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